including a phase-magnitude error detector means providing a phase error signal and a magnitude error signal related respectively to impedance phase angle error and impedance magnitude error, and said matching network comprising at least a first variable impedance device having a driven element for varying the impedance thereof and a second variable impedance device having a driven element for varying the impedance thereof; the method comprising:

supplying said phase and said magnitude error signals to a fuzzy logic controller, wherein each of said error [signal] signals has a magnitude and direction[,];

C3

applying each of said phase and magnitude error [signal] signals to a fuzzy logic inference function based on a number of overlapping fuzzy sets, and where [the] a value of each of said phase and magnitude error [signal] signals enjoys membership in one or more fuzzy sets;

applying fuzzy logic rules to said phase and magnitude error signals according to [the] said one or more fuzzy sets for which said [first and second] phase and magnitude error signals enjoy membership;

obtaining drive signal values based on said fuzzy logic rules for each of said phase and magnitude error signals;

weighting said drive signal values according to the respective one or more fuzzy sets inference [functions] for which said phase and magnitude error signals enjoy membership; and

combining said weighted drive signal values to produce an output drive signal for the driven element of said first variable impedance device [driven element].

2. (TWICE AMENDED) Fuzzy logic method of tuning an RF matching network according to claim 1, further comprising:

obtaining additional drive signal values based on additional fuzzy logic rules for each of said [first and second] phase and magnitude error signals;

weighting said additional drive signal values according to additional respective fuzzy inference functions; and

C3 CON'D

combining [such] said weighted additional drive signal values to produce an output drive signal for the driven element of said second variable impedance device [driven element].

3. (TWICE AMENDED) Fuzzy logic method of tuning an RF matching network according to claim 2, wherein said fuzzy logic rules and said additional fuzzy logic rules comprise a matrix of NxM drive signal values, where N is the number of fuzzy sets of said phase error signal and M is the number of fuzzy sets of said magnitude error signal, and each of said drive signal [value] values and said additional drive signal values corresponds to a given set of said phase signal and a given set of said magnitude error signal.

C4

5. (TWICE AMENDED) A fuzzy logic controller for tuning [an RF] a radio frequency (RF) matching network, wherein said matching network is positioned between a source of applied RF power at a given frequency and at a given impedance, and an RF load having a non-constant impedance, said matching network including a phase-magnitude error detector means providing a phase error signal and a magnitude error

signal related respectively to impedance phase angle error and impedance magnitude error, and said matching network comprising at least a first variable impedance device having a driven element for varying the impedance thereof and a second variable impedance device having a driven element for varying the impedance thereof; the fuzzy logic controller comprising:

an input means receiving values of said phase and magnitude error signals;

means for applying the values of said phase and magnitude error signals to a fuzzy logic inference function based on a number of overlapping fuzzy sets, and where a [the values] value of each of said phase and magnitude error signals enjoy membership in one or more fuzzy sets;

C4 cont

means for applying fuzzy logic rules to said phase and magnitude error signals according to fuzzy sets for which said error signals enjoy membership;

means for obtaining drive signal values according to said fuzzy logic rules for each [set] of said fuzzy sets for which said error signals enjoy membership;

means for weighting said drive signal values according to the respective fuzzy inference functions for the values of said phase and magnitude error signals; and

means for combining said weighted drive signal values to produce an output drive signal for said first variable impedance device driven element.

6. (TWICE AMENDED) Fuzzy logic controller according to claim 5, further comprising:

means for obtaining additional drive signal values based on additional fuzzy logic rules for each of said phase and magnitude error signals;

means for weighting said additional drive signal values according to additional respective fuzzy inference functions; and

means for combining [such] said weighted additional drive signal values to produce an output drive signal for said second variable impedance device driven element.

C4 contd

7. (TWICE AMENDED) Fuzzy logic method of tuning a tunable [RF] radio frequency (RF) device of the type having an input at which is applied RF power at a given frequency and at a given impedance, and an output, including an error detector means providing a first error signal and a second error signal, and said tunable RF [means] device including at least a first variable impedance device having a driven element for varying the impedance thereof and a second variable impedance device having a driven element for varying the impedance thereof; the method comprising:

supplying said first and said second error signals to a fuzzy logic controller, wherein each of said first and said second error [signal] signals has a magnitude and direction[,];

applying each of said first and said second error [signal] signals to a fuzzy logic inference function based on a number of overlapping fuzzy sets, and generating a membership value that corresponds to [the] an amount of overlapping membership of the error [signal value] signals in one or more fuzzy sets;

applying a plurality of fuzzy logic rules to said first and second error signals according to the fuzzy sets for which said first and second error signals enjoy membership;

obtaining a plurality of drive signal values based on said plurality of fuzzy logic rules for each of said first and second error signals;

C4 cont'd

weighting said drive signal values according to the respective membership values for said first and second error signals; and

combining said weighted drive signal values to produce an output drive signal for said first variable impedance having said first variable impedance device driven element.

---

9. (TWICE AMENDED) An electrical network comprising:

C5

a radio frequency (RF) generator for generating an RF signal, the RF generator having a source impedance;

a load receiving the RF signal, the RF signal providing a driving energy to the load, the load having a variable load impedance;

a matching network interposed between the RF generator and the load, the matching network having a variable network impedance, the matching network detecting at least one of an impedance phase and an impedance magnitude error and generating at least one of a respective phase error signal and a magnitude error signal, the matching network varying at least one of the impedance phase and the impedance magnitude error in order to vary the network impedance;

a fuzzy inference module receiving the at least one of the respective phase and magnitude error signals and defining a membership value that varies in accordance with membership in at least one fuzzy set; and

a controller receiving the at least one respective phase error signal and magnitude error signal, the controller applying fuzzy logic rules to the at least one of the respective impedance phase error signal and the impedance magnitude error signal according to the fuzzy sets for which said error signals enjoy membership in order to generate at least one control signal to vary the network impedance, thereby matching the source impedance and the load impedance.

C3

11 ~~12.~~ (TWICE AMENDED) The network of claim 10 ~~11~~ wherein the controller further comprises a defuzzification module, the defuzzification module converting the at least one fuzzy output to the at least one control signal.

C4

15 ~~16.~~ (TWICE AMENDED) An electrical network comprising:

C7

a radio frequency (RF) generator for generating an RF signal, the RF generator having a source impedance;

a load receiving the RF signal, the RF signal providing a driving energy to the load, the load having a variable load impedance;

a matching network interposed between the RF generator and the load, the matching network having a variable network impedance, the matching network detecting at least one network parameter and generating at least one sensed signal, the matching network varying the network impedance in order to match the variable load impedance and the source impedance, wherein the at least one sensed signal comprises at least one of an impedance phase error signal and an impedance magnitude error signal;

a fuzzy inference module receiving the at least one sensed signal and defining a membership value that varies in accordance with membership in at least one fuzzy set; and

C7

a controller receiving the at least one sensed signal, the controller applying fuzzy logic rules to the at least one sensed signal according to the fuzzy sets for which said phase and magnitude error signals enjoy membership in order to generate at least one control signal to vary the network impedance, thereby matching the source impedance and the load impedance.

C8

17 ~~19.~~ (TWICE AMENDED) The network of claim 15 ~~16~~ wherein the controller further comprises a defuzzification module, the defuzzification module converting at least one fuzzy output to the at least one control signal.

C9

22 ~~24.~~ (TWICE AMENDED) A method of tuning a radio frequency (RF) impedance matching network having an input which receives RF power and an output which applies the power to a RF load, the matching network having a variable impedance, comprising the steps of:

determining an impedance phase error and an impedance magnitude error and generating a corresponding phase error signal and a corresponding magnitude error signal;

applying the impedance phase and impedance magnitude errors to a fuzzy logic inference function, the phase and magnitude error signals each having at least one respective membership value in at least one fuzzy set; and

C9

applying fuzzy logic rules to the impedance phase and impedance magnitude error signals according to the fuzzy sets for which said error signals enjoy membership to generate fuzzy output signals based upon the phase and the magnitude error signals and generating a control signal to adjust the variable impedance of the matching network.

C10

27 ~~27.~~ (TWICE AMENDED) The method of claim 22 ~~24~~ wherein the step of applying logic rules further comprises the step of weighting at least one respective fuzzy output value according to the at least one respective membership value.

C11

28 ~~31.~~ (TWICE AMENDED) A method of tuning a radio frequency (RF) impedance matching network having an input which receives RF power and an output which applies the power to a RF load, the matching network having a variable impedance, comprising the steps of:

determining a network parameter and generating a corresponding sensed signal that varies in accordance with the network parameter;

applying the corresponding sensed signal to a fuzzy logic inference function, the corresponding sensed signal having at least one respective membership value in at least one fuzzy set; and

applying fuzzy logic rules to the corresponding sensed signal according to fuzzy sets for which said sensed signal enjoys membership;

generating fuzzy output signals based upon the corresponding sensed signal; and

C 11 con't

generating a control signal to adjust the variable impedance of the matching network based upon the fuzzy output signals.

29
~~33.~~ (TWICE AMENDED) The method of claim 28 ~~31~~ wherein the step of applying fuzzy logic rules further comprises applying logic rules to the at least one respective membership value to generate at least one respective fuzzy output value.

C 12

30
~~34.~~ (TWICE AMENDED) The method of claim 28 ~~31~~ wherein the step of applying fuzzy logic rules further comprises the step of weighting at least one respective fuzzy output value according to the at least one respective membership value.

31
~~35.~~ (TWICE AMENDED) The method of claim 30 ~~34~~ wherein the step of applying fuzzy logic rules further comprises the step of combining said weighted at least one respective fuzzy output value to produce the control signal.